Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Third Periodic Review of the	)	MB Docket 07-91
Commission's Rules & Policies	)	
Affecting the Conversion	)	
To Digital Television	)	

To: The Commission

Comments of Hammett & Edison, Inc.

1. The firm of Hammett & Edison, Inc., Consulting Engineers, respectfully submits these comments in the above-captioned proceeding relating to DTV broadcasting. Hammett & Edison, Inc. (H&E) is a professional service organization that provides consultation to commercial and governmental clients on communications, radio, television, and related engineering matters. H&E is well qualified to make comments on this matter, its professional staff having been involved for over 50 years with the design of individual TV broadcast stations, their applications for FCC authorization, and various assessments of station performance. H&E has participated over the years in almost all of the rulemakings involving the digital television (DTV) broadcast service.[1]

I. Continued Use of EC3 Diminishes the Usefulness of a 0.5% "de minimis" Allowance

2. In our June 13, 1997, *Petition for Reconsideration* of the Fifth and Sixth Report & Orders (R&Os) to MM Docket 87-268, we pointed out a serious problem with the Longley-Rice terrain-sensitive propagation model that the Commission requires be used when conducting OET-69 coverage and interference studies. That is the "Error Code 3" or "EC3" problem. Specifically, in cases where the actual horizon from a given cell or transmitter location is less than 0.1 times or greater than 4 times the distance to the smooth earth horizon, the Longley-Rice algorithm will return an "Error Code 3"

[1] H&E has filed the following comments regarding DTV generally and specifically regarding the FCC's implementation of Longley-Rice algorithm used to predict DTV service:
1. February 3, 1993, MM Docket 87-268 reply comments
2. June 13, 1997, MM Docket 87-268 *Petition for Reconsideration*
3. December 11, 1998, CS Docket 98-201 comments (relating to the Longley-Rice algorithm and EC3)
4. August 26, 1999, MM Docket 87-268 First Biennial Review comments
5. May 17, 2000, MM Docket 00-39 comment
6. June 16, 2000, MM Docket 00-39 reply comments
7. January 16, 2003, MM Docket 00-39 comments in support of the November 8, 2002, Sinclair *Petition for Reconsideration*
8. October 7, 2004, MM Docket 03-15 *Petition for Reconsideration.*

that, according to the program documentation, means that internal program calculations show parameters out of range, and any reported results are dubious or unusable. Under the current OET-69 protocols, the procedure used by the FCC when such a Longley-Rice error occurs, whether during determination of potential service or potential interference, has been to treat that cell as having interference-free service. That is, the "desired" signal is assumed to be above its signal threshold, even though it may not be, and the desired signal is not checked for interference from "undesired" signals. We call this approach "free parking" in EC3 cells. While this assumption facilitated creation of the DTV Tables of Allotments, it ill-serves broadcasters and ultimately will ill-serve the viewing public, because radio waves propagate according to the laws of physics, and not according to convenient, but often incorrect, assumptions.

3. The Commission initially chose not to address the EC3 problem,[2] so in our April 26, 1999, comments to MM Docket 87-268, we again addressed this problem. We provided a comprehensive analysis of the severity of EC3 for all 1,601 DTV allotments in the contiguous United States (*i.e.*, excluding Alaska, Hawaii, Puerto Rico, Guam and the Virgin Islands), with the following results:

Percentage of DTV Allotments	Percent of Population in Cells with EC3
2.8%	<0.1%
7.1	0.1 – 1
16.0	1 – 5
16.0	5 – 10
23.4	10 – 20
28.1	20 – 50
6.5	50 – 90
0.1	>90

4. We reported that, on the average, 18.2% of a DTV allotment's population fell in EC3 cells, which was troubling then, and is all the more troubling now. It made little sense to have a 2% *de minimis* criterion for DTV stations when the underlying prediction model had an average uncertainty of over 18%. And it bordered on silly to use a 0.1% criterion, while retaining a prediction model with an average uncertainty that is 182 times greater.

5. On August 26, 1999, H&E took the initiative by filing *Biennial Review of DTV Technical Issues* comments to the MM Docket 87-268 record, even though the Commission had not yet initiated

[2] At footnote 121 to the January 19, 2001, MM Docket 00-39 R&O, the Commission did not dispute the numbers in Paragraph 3 regarding the frequency of cells returning EC3; rather, the Commission stated "our review of its [H&E's] information reveals no benefit that would warrant reversing our earlier decision" [not to change how cells returning EC3 are treated]. Thus, the Commission apparently found "no benefit" to taking a step that would eliminate an average uncertainty of 18% to OET-69 interference calculations - a rather stunning statement.

that promised rulemaking. Paragraph 2 of our comments noted that, at Paragraph 116 of the April 21, 1997, Fifth Report & Order (R&O) to MM 87-268, the Commission stated that it would hold

> a periodic review every two years until the cessation of analog service

in order to ensure the smooth introduction of DTV and the timely recovery of spectrum upon the end of analog service. That paragraph went on to state that

> During these reviews, we will address any new issues raised by technological developments, necessary alterations in our rules, or other changes necessitated by unforeseen circumstances.

Since that two-year period had tolled in April of 1999, without the promised biennial review being issued, we had hoped that our filing would trigger that badly needed review. Finally, on March 8, 2000, the Commission issued a Notice of Proposed Rulemaking (NPRM) for its first Periodic Review of DTV Issues. Unfortunately, many of the serious technical issues addressed in our jump-start August 1999 filing were not addressed in the NPRM, so we again raised those issues in our subsequent MB Docket 00-39 comments (discussed in the next paragraph). By not addressing these troubling technical issues in the MB 00-39 NPRM, and thus denying interested parties an opportunity to comment on them, we believe that the Commission lost a valuable opportunity to significantly improve the accuracy of its predictive interference model for DTV.

6. In our May 17, 2000, MB Docket 00-39 (First DTV Periodic Review) comments, we provided maps showing the EC3 cells of representative DTV allotments; those figures are repeated here, as Figures 1 through 3. The prevalence of EC3 cells was appalling in 2000, and is equally appalling now. Our June 16, 2000, our MB Docket 00-39 reply comments repeated that the EC3 problem needed to be fixed. Retaining EC3 with its nationwide average uncertainty of 18% while applying "*de minimis*" criteria of 0.5% (to other DTV stations and DTV allotments) and 2% (to NTSC stations) was a classic case of precision without accuracy.

7. On January 27, 2003, the Commission released its Second DTV Periodic Review NPRM, MM Docket 03-15. H&E did not file comments or reply comments because the Second DTV Periodic Review either did not address issues with which we disagreed (*e.g.*, requiring stations with two in-core channels to make their post-transition channel election by May 1, 2005), or addressed issues on which we did not feel qualified to comment (*e.g.*, the pace of the DTV receiver sales). Also, since the MB Docket 03-15 NPRM did not ask for further comment on the issues raised in our MB Docket 00-39 comments, we concluded that the Commission was still mulling over those issues, which might then be addressed in the MB Docket 03-15 R&O. Instead the September 7, 2004, MB Docket 03-15 R&O was silent on these critical technical issues.

8. Accordingly, on October 6, 2004, we filed a *Petition for Reconsideration* of the MB Docket 03-15 R&O. We pointed out that the continued establishment of "free parking" through EC3 represented a serious threat to the integrity of the post-transition DTV Table of Allotments, and implored the Commission to solve the problem by simply ignoring EC3, and accepting the Longley-Rice signal level and interference results for all cells. We noted that in the December 11, 1998, H&E comments to CS Docket 98-201, comparisons of Longley-Rice EC3 results to the results given by the Terrain Integrated Rough Earth Model (TIREM) for the same path indicated that greater accuracy could be obtained by simply ignoring the EC3 warning. This "false-alarm" nature of EC3 was recognized in the February 2, 1999, CS Docket 98-201 R&O, where, at Paragraph 85, the Commission concluded that for Satellite Home Viewer Act (SHVA) signal prediction purposes, the EC3 warning should be ignored.

9. The Commission still has not changed its flawed EC3 policy with respect to DTV. While this policy potentially benefits modifying stations it can penalize the supposedly protected station, by giving the modifying station "free parking" in coverage areas of the protected station. It is always possible that an EC3 cell, presumed to be above threshold and not checked for interference, might actually turn out to be above-threshold and interference-free if the Longley-Rice results are accepted. It is nonetheless unconscionable to continue to deny DTV stations the interference protection that they are entitled to receive by continuing to allow "free parking"; that is, by continuing to assume interference-free service in EC3 cells.

10. The United States is now in the final round of post-transition DTV channel applications. This is the last chance for the Commission to provide engineering integrity to the DTV applications that now need to be filed to document each station's post-transition DTV operation. We again implore the Commission not to let this opportunity fade away. The solution is simple, by stating in the R&O to this rulemaking that all stations must conduct their final, post-transition interference analysis with EC3 ignored (and to similarly ignore EC3 for any subsequent applications), as is done in OET Bulletin No. 72.

II. Use of Actual Elevation Patterns, Actual EBT, Actual MBT, and Depression Angle Calculation Error

11. Another flaw in the Commission's OET-69 methodology is the continued insistence on the use of generic elevation patterns and generic electrical beam tilt (ebt). Especially at UHF, where transmitting antenna elevation patterns tend to be narrow (on the order of only 1° to 2° wide at their half power beam width [HPBW] points), the failure to routinely permit the use of a transmitting antenna's actual elevation pattern and actual beam tilt introduces significant and unnecessary errors.

Further, when the transmitting antenna employs mechanical beam tilt (mbt) in addition to ebt, the current Commission practice of basing calculations on the distorted horizontal-plane azimuth pattern rather than the main-beam azimuth pattern coupled with the actual elevation pattern,[3] actual ebt, and actual mbt,[4] introduces huge calculation errors.

12. The present implementation of OET-69 contains a serious error, resulting in miscalculation of the depression angle to cells under study. We brought this issue to the Commission's attention, first in our May 17, 2000, MM Docket 00-39 comments, and again in our October 7, 2004, *Petition for Reconsideration* of the September 7, 2004, MB Docket 03-15 R&O. We pointed out that, unlike the EC3 problem where an conscious engineering decision was made by the Commission, the depression angle miscalculation error was an inadvertent coding error by the software developer. This coding error caused the depression angle to cells under study to be based on the transmitting antenna's height above ground level (AGL) rather than its height above mean sea level (AMSL). When a transmitting antenna gets its height from a mountain, the difference between these two heights can be huge. For example, at the Mt. Wilson antenna farm near Los Angeles, a typical AGL height is 90 meters, but a typical AMSL height is 1,800 meters. This results in large depression angle calculation errors of 2.5° to 3° in the Los Angeles basin, where viewers are located.

13. Although the Commission then modified its OET-69 software to give staff the *option* of correctly calculating the depression angles to cells under study (apparently only when so requested by an applicant), to this day the Commission has not modified its OET-69 software to allow staff to use an actual elevation pattern, actual ebt, and actual mbt (when used). This is the case even though in Paragraph 66 of the January 19, 2001, MB Docket 00-39 R&O the Commission stated

> However, in a special case, where one of the suggested revisions would improve the accuracy of the analysis and would make a critical difference, an application may contain a showing using an alternate analysis in support of a waiver request.

Thus, even when a station's proposed transmitting antenna involves a design with both ebt and mbt, and it would make a "critical difference" to correctly use the main beam azimuth pattern, the actual elevation pattern, the actual ebt and actual mbt, the Commission's processing software is incapable of doing so, and therefore calculations continue to be made based on the horizontal plane azimuth pattern and using the generic UHF elevation pattern with its generic ebt of 0.75°.

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[3] It should be noted that when only ebt is employed, the main beam and horizontal plane relative field azimuth patterns are congruent. However, when mbt is employed, the main beam and horizontal plane azimuth patterns are no longer identical. The difference becomes more extreme as the amount of mbt approaches the amount of ebt, with the most severe departure between the two pattern shapes occurring when the amount of mbt equals the ebt. The Commission's rules do not allow a transmitting antenna to have mbt that is greater than the ebt.

[4] It should also be noted that, unlike ebt, mbt is a *two-valued* parameter; both the mbt in degrees, and the direction of the mbt in degrees True, must be specified.

14. At Paragraph 138 of the August 6, 2007, MB Docket 87-268 Seventh R&O and Eighth Further Notice of Proposed Rulemaking (FNPRM), the Commission makes the following rather amazing claim:

> Our analysis was performed using computer software techniques that have been validated through extensive testing and comparison of results with similar software used by other parties participating in this proceeding. We are confident that the result of our interference analysis is correct...

We take exception to this claim. In the past, the Commission position has been that while its OET-69 software (including the FLR and tv_process programs) might have limitations and shortcomings, the FCC software result was definitive in cases of dispute. Now the Commission has made the claim that its OET-69 software gives "correct" results, with the inference that it does so in all situations. H&E submits that this is most definitely *not* the case. To the contrary, the Commission's OET-69 software has known, well-documented technical limitations and defects, as detailed elsewhere in these comments.

15. We accordingly implore the Commission not to force broadcasters to base their post-transition DTV applications on flawed software having known and correctable inaccuracies. Specifically, broadcasters need to be allowed to supply an actual elevation pattern, actual ebt, actual mbt (where used), and to then base the OET-69 calculations on the main beam azimuth pattern combined with the actual ebt, mbt and elevation pattern, rather than a horizontal plane azimuth pattern. Further, only correctly calculated depression angles to cells under study should be allowed, and no "free parking" in EC3 cells should be allowed.

III. 0.5% "*de minimis*" Cap

16. We agree that the proposed *de minimis* allowance and cap are good ideas, but the NPRM was not clear about how the Commission plans to establish the cap. We see two possible interpretations:

Interpretation 1: "Locked in on February 18." If Station A causes, say, 1% interference to Station B on February 18, 2009, Station A would be precluded from causing *any* additional interference to Station B. In practice, this would mean that Station A could never change its antenna or site. We expect that there will be a large number of stations that will cause >0.5% interference to another station on February 18, 2009.

Interpretation 2: "Additional 0.5% allowed." Station A could cause any amount of interference to Station B on February 18, and would still be entitled to one additional 0.5% bite. We prefer this interpretation.

17. The record-keeping problem. If the Commission adopts Interpretation 2, as we urge, how will the Commission monitor which stations have used up their 0.5% allowance? One possibility might be to allow stations a period of two years in which to make adjustments that can result in a 0.5% "bite" under Interpretation 2, after which they would be locked in under Interpretation 1. This would require only limited additional record-keeping.

18. We submit that a 0.5% interference cap per station is a good idea, since it is unlikely that any station would ever receive more than 1.5% aggregate new interference. In most markets, where stations are collocated, or nearly so, new interference from one station would tend to mask new interference from another station, so the net reduction in coverage for both stations would be just 0.5%. While we realize there could be exceptions, the potential for significant harm to any one station seems small.

IV. Summary

19. The Commission is now entering the final round of the DTV transition. Many DTV stations will be filing applications for their post-transition DTV facilities. The OET-69 interference studies pertaining to those applications, and the 0.5% *de minimis* allowance, will be significantly flawed if the Commission does not

1. Ignore EC3 and accept Longley-Rice results for coverage and interference.

2. Correctly calculate the depression angles to cells under study in all cases.

3. Allow broadcasters to use their main beam azimuth pattern (as opposed to the horizontal plane azimuth pattern), actual elevation pattern, actual ebt, and actual mbt (where used).

We implore the Commission to incorporate these changes in this final stage of the DTV transition.

V. List of Figures

20. The following figure has been prepared as a part of these MB Docket 07-91 comments:

    1. Maps showing EC3 cells for a Los Angeles UHF DTV allotment
    2. Maps showing EC3 cells for a West Virginia DTV allotment
    3. Map showing EC3 cells for Pennsylvania-area NTSC stations and DTV allotments
    4. Main beam versus horizontal plane azimuth pattern comparisons.

Respectfully submitted,

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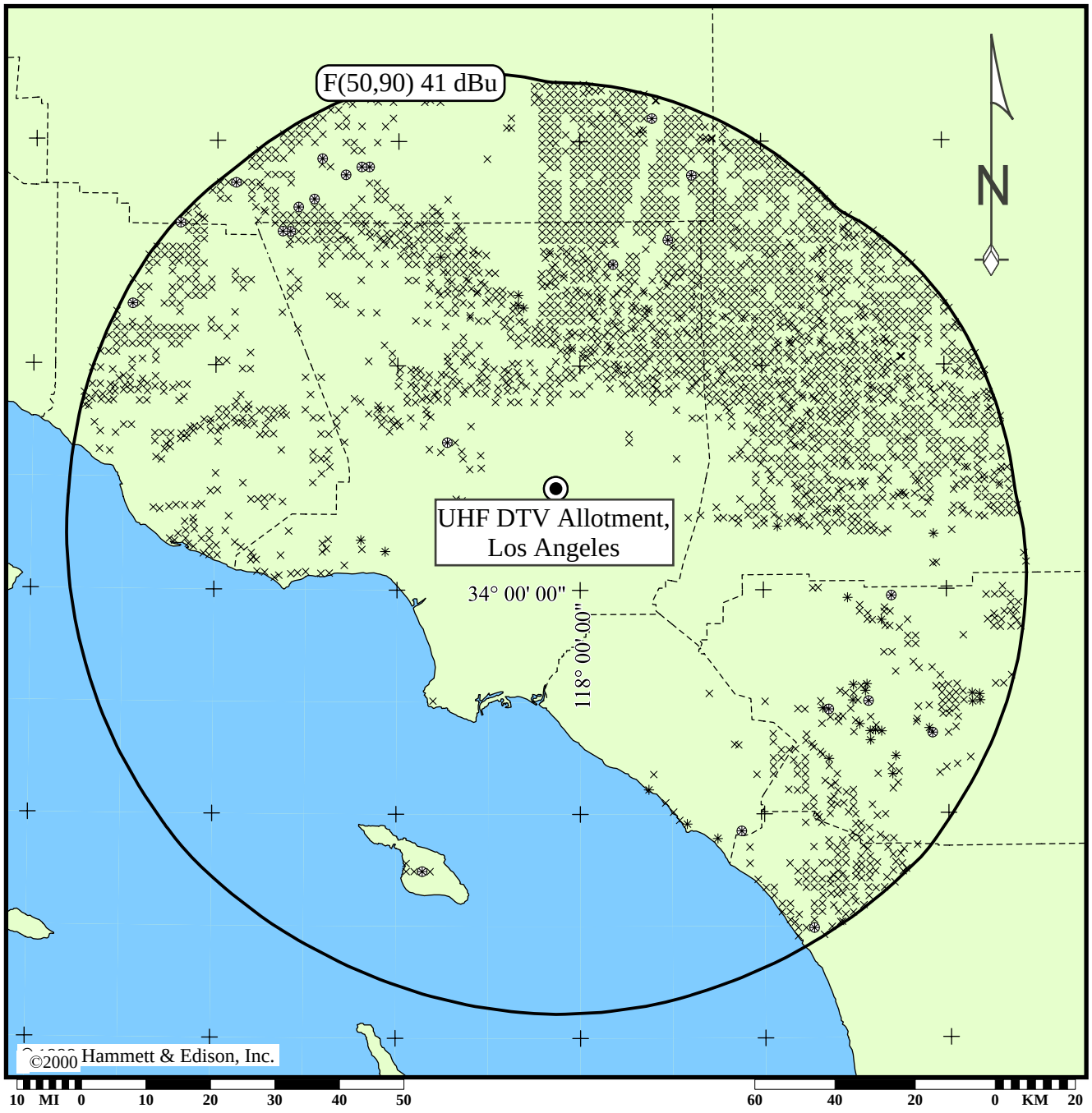
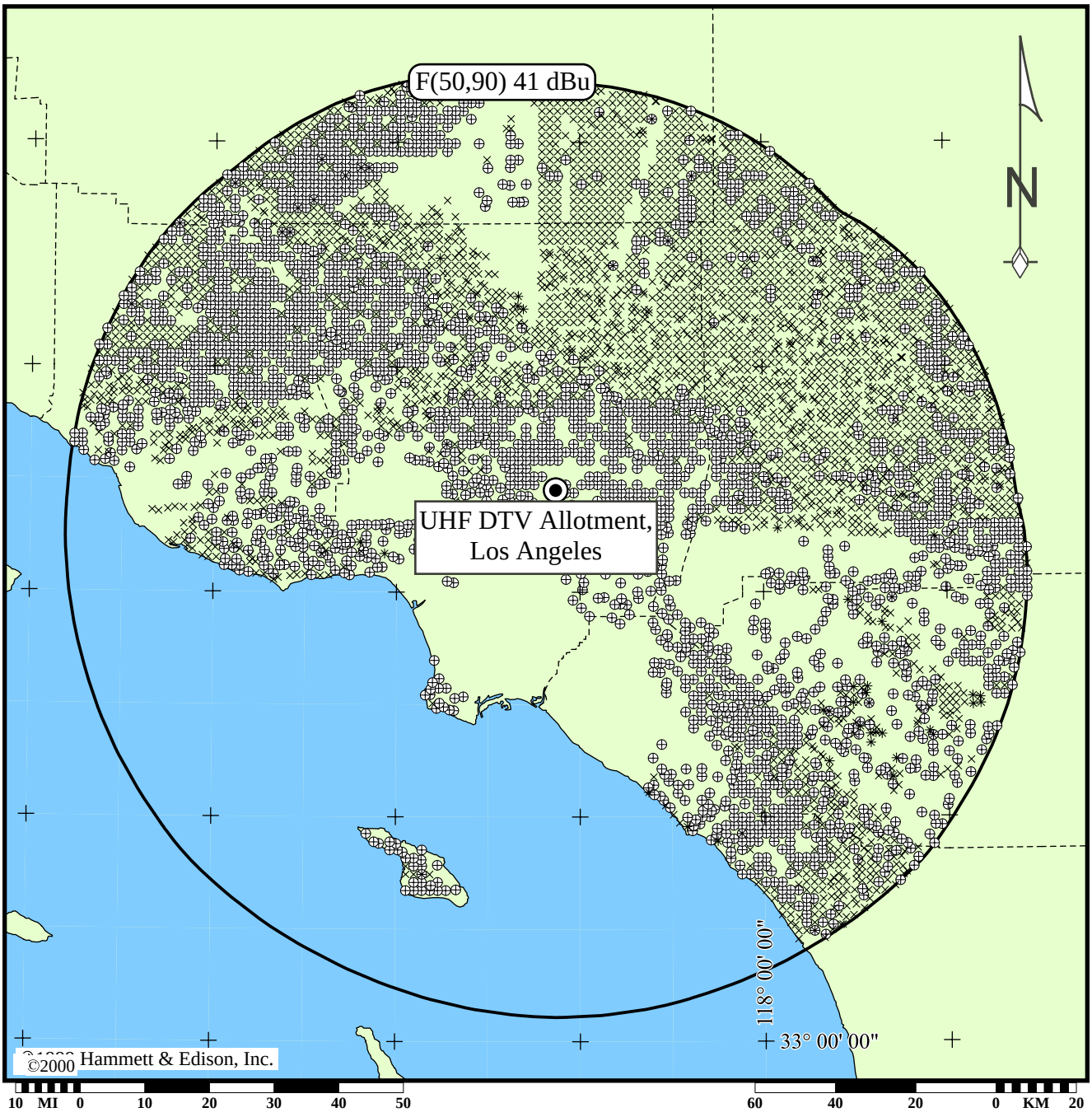
OET-69 Coverage for a Los Angeles, California, UHF DTV Allotment (without EC3 Cells)



Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic Coordinate marks shown at 30-minute increments.

× = No Signal (below threshold)
∗ = Interference (with population in cell)
⊛ = Interference (without population in cell)

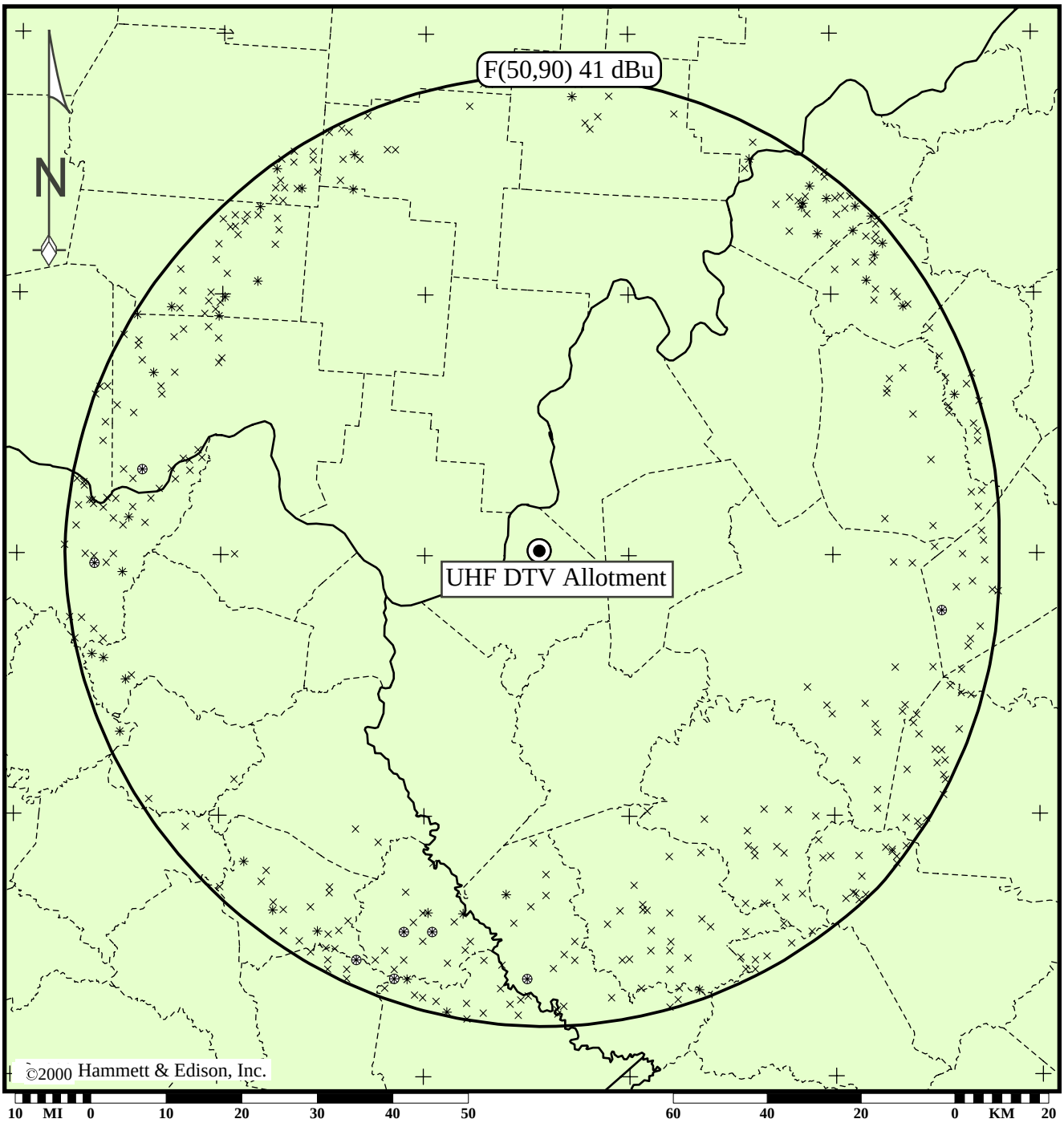
OET-69 Coverage for a Los Angeles, California, UHF DTV Allotment (with EC3 Cells)



Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 30-minute increments.

× = No Signal (below threshold)
∗ = Interference (with population in cell)
⊛ = Interference (without population in cell)
⊕ = Longley-Rice error cell

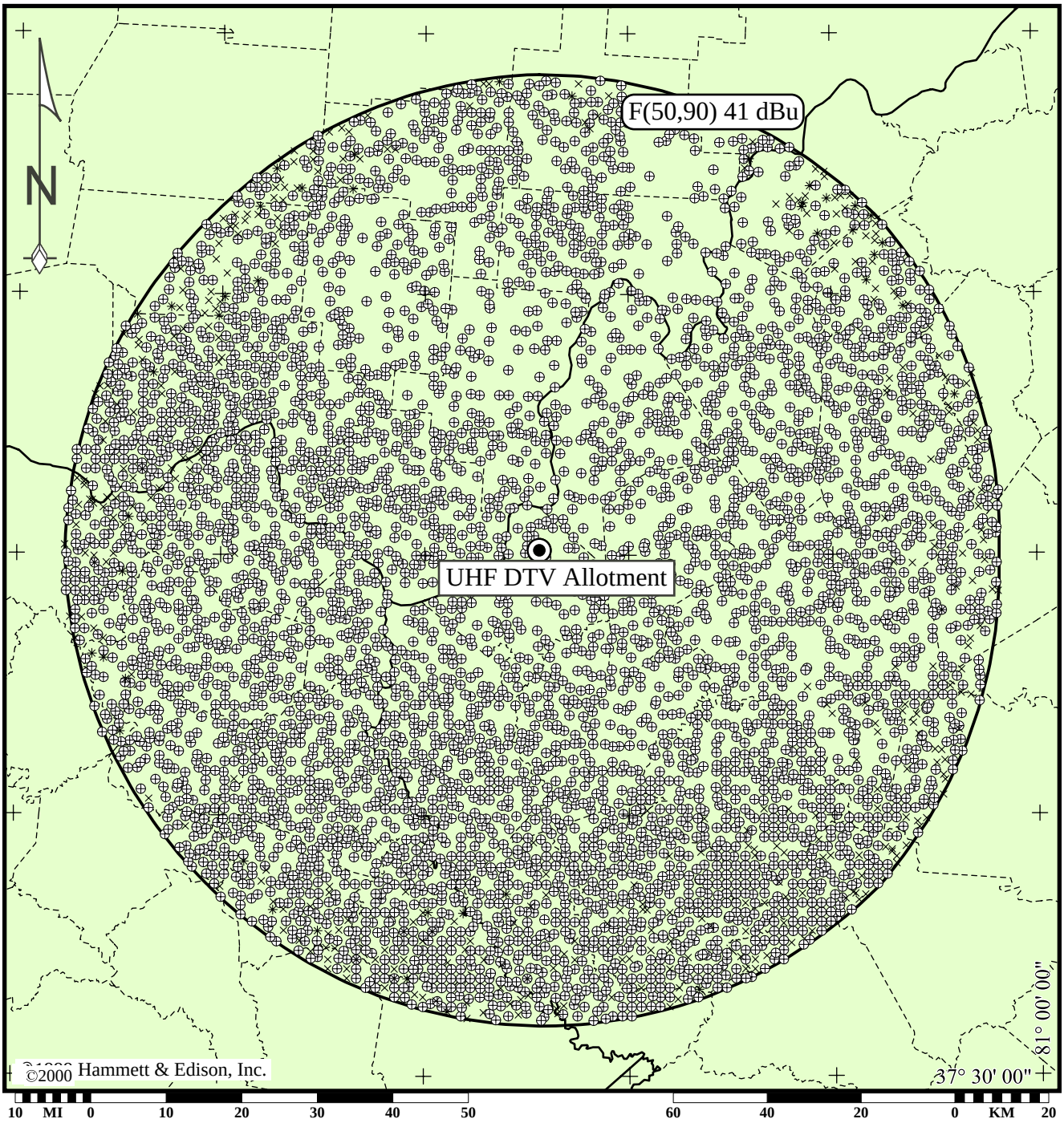
OET-69 Coverage for West Virginia UHF DTV Allotment (without EC3 Cells)



Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic Coordinate marks shown at 30-minute increments.

× = No Signal (below threshold)
∗ = Interference (with population in cell)
⊛ = Interference (without population in cell)

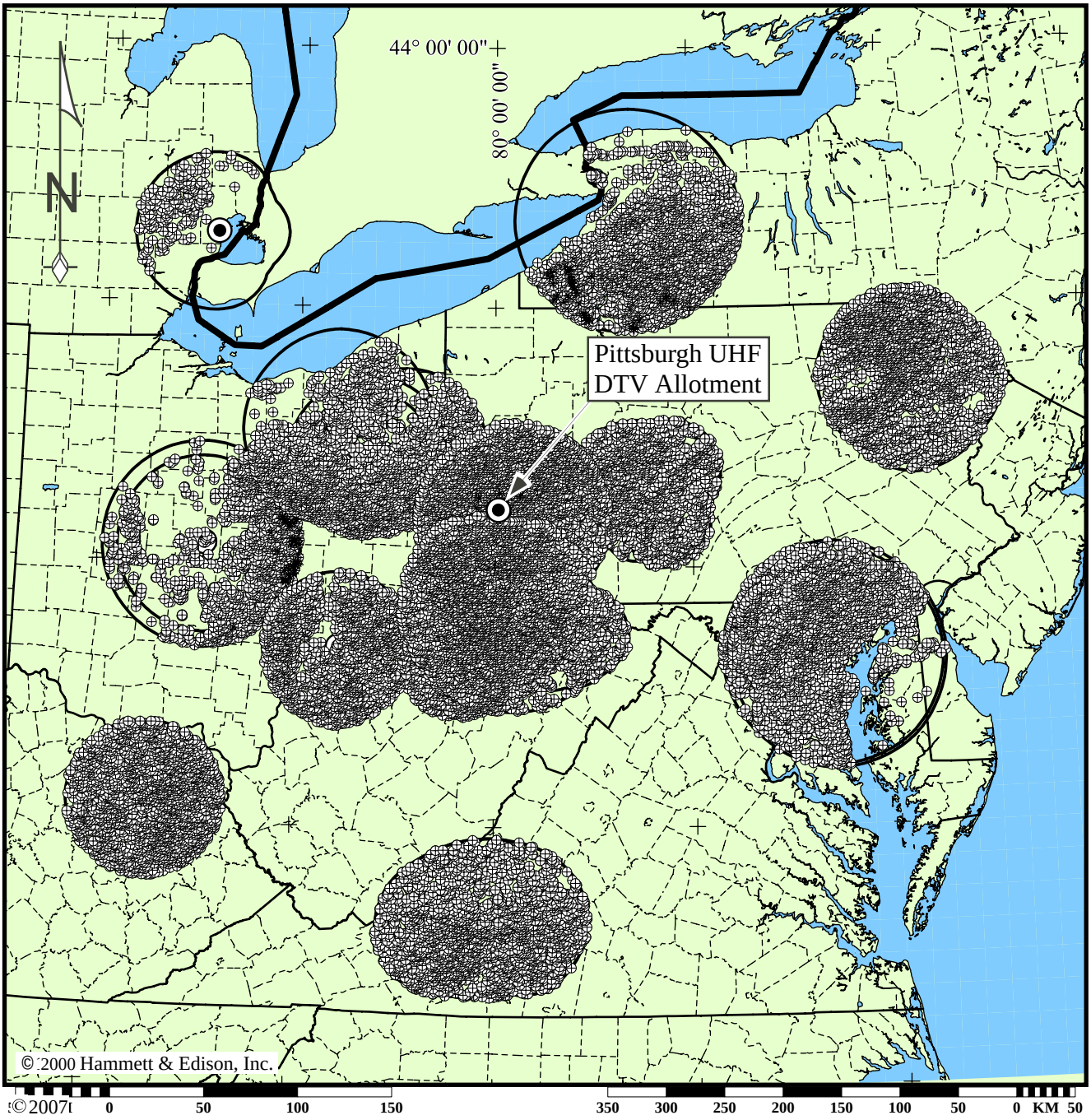
OET-69 Coverage for West Virginia UHF DTV Allotment (with EC3 Cells)



Lambert conformal conic map projection. Geographic coordinate marks shown at 30-minute increments.

× = No Signal (below threshold)
∗ = Interference (with population in cell)
⊛ = Interference (without population in cell)
⊕ = Longley-Rice error cell

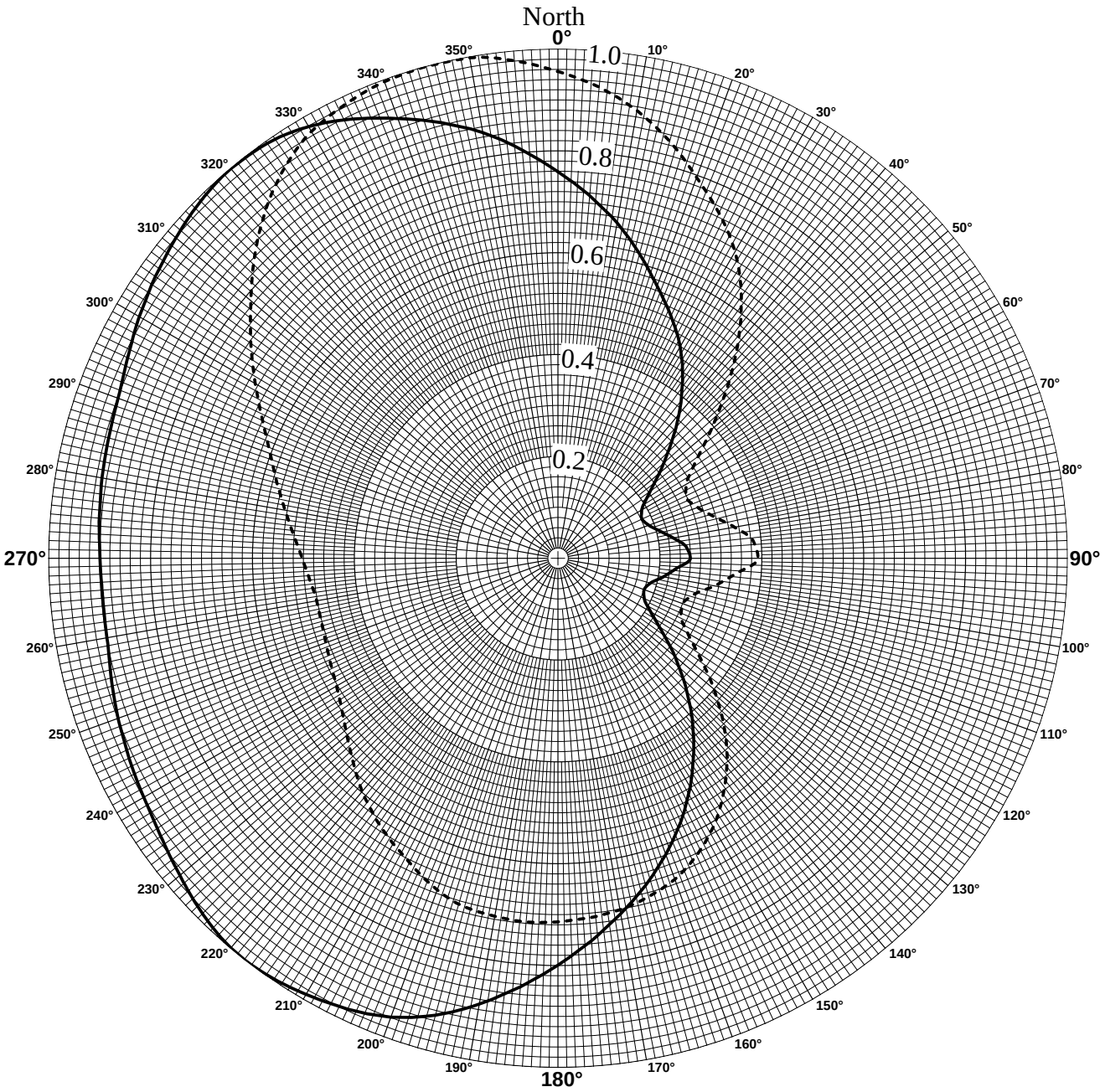
OET-69 Interference Study for a Pittsburgh, Pennsylvania UHF DTV Allotment Showing Extent of EC3 Cells in the Protected Contours of Stations Close Enough to Require Study



Map data taken from Sectional Aeronautical Charts, published by the National Ocean Survey. Geographic coordinate marks shown at 120-minute increments.

× = No Signal (below threshold)
✳ = Interference (with population in cell)
⊛ = Interference (without population in cell)
⊕ = Longley-Rice error cell

Comparison of Main-Beam and Horizontal Plane Azimuth Patterns for Station with 2° EBT Plue 1° at 250°T - Relative Field -



Comparison of Main-Beam and Horizontal Plane Azimuth Patterns for Station with 1.6° EBT Plus 0.6° MBT at 225°T - Relative Field -